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ABSTRACT

This report includes a collection of workshop materials which address ways microcomputers can be used in evaluation and assessment and what basic information should be covered in introducing newcomers to the use of microcomputers. It is designed for use by experienced trainers with microcomputer experience but with few workshop support materials. The following major types of program are described: word processing; database management; electronic spreadsheets; special uses of microcomputers in evaluation and assessment (instrument generation, data collection and test scoring, statistical analysis); graphic tools; communication tools; and networking. Descriptions include a discussion of the concepts related to each program type, a sample of representative commercially-available programs, and a list of references for more information. A final chapter discusses planning for microcomputer use and outlines a three-step process to serve as a guide from the consideration of capabilities to the selection of a microcomputer system. Also included are criteria for review of professional software, a hardware specifications worksheet, hardware evaluation worksheet, and a list of families of microcomputers by software compatibility. (LMM)

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No. 89 MATERIALS FOR A WORKSHOP ON USING MICROCOMPUTERS IN EVALUATION AND ASSESSMENT

PETER J. GRAY
Northwest Regional Educational Laboratory
DENNIS DECK
Northwest Regional Educational Laboratory

November 1983

Nick L. Smith, Director
Research on Evaluation Program
Northwest Regional Educational Laboratory
300 S. W. Sixth Avenue, Portland, Oregon 97204

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PREFACE

The Research on Evaluation Program is a Northwest Regional Educational Laboratory project of research, development, testing, and training designed to create new evaluation methodologies for use in education. This document is one of a series of papers and reports produced by program staff, visiting scholars, adjunct scholars, and project collaborators--all members of a cooperative network of colleagues working on the development of new methodologies.

In what ways can microcomputers be used in evaluation and assessment? What basic information should be covered in introducing newcomers to the use of microcomputers? This report includes a collection of workshop materials which address these questions. This is not a complete workshop guide, but a valuable collection of introductory concepts, samples of commercially available programs, and references, for use by experienced trainers with microcomputer experience but with few workshop support materials. Revised through use in a variety of workshop settings, these materials provide an excellent basis for introducing professional staff to the use of microcomputers in evaluation and assessment.

Nick L. Smith, Editor
Paper and Report Series

FOREWORD

The information in this booklet represents the handouts used in an introductory workshop on using microcomputers in evaluation and assessment. This workshop was presented a number of times jointly by the authors, and on several occasions separately by them, between January and November 1983.

Depending on the nature of the specific workshop setting, these handouts were used either alone, or were accompanied by demonstrations using representative software and hands-on tutorials for participants. These demonstrations and tutorials are not included in this booklet because of their specificity. A workshop leader who chooses to use these handouts should develop demonstrations and tutorials based on software with which she or he is familiar, and based on the needs of the particular audience.

We assume that a person using these handouts will have sufficient background and experience with microcomputers, and with the types of software discussed in the handouts, to answer general questions. The handouts are intended to provide an introduction to these topics. Demonstrations and tutorials can be developed to match the need for indepth information on the part of specific audiences.

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MATERIALS FOR A WORKSHOP ON USING
MICROCOMPUTERS IN EVALUATION AND ASSESSMENT

INTRODUCTION

The purpose of these workshop materials is to introduce participants to the many and varied uses of microcomputers in evaluation. Microcomputers may be thought of as very powerful all-purpose tools. They can be of benefit at every stage of the evaluation process. As shown in the figure below, they can be used from proposal writing and planning to reporting.

The diversity of software programs which have specific uses is what makes microcomputers so versatile. With word processing programs, a computer can be used to create, edit, and print textual material. With electronic spreadsheets and statistical programs, computers can be used to record, manipulate, analyze, summarize, and report numbers. With graphic programs, computers can be used to communicate information in visually attractive and understandable ways.

Each of the major types of programs listed below is described in this booklet. Those descriptions consist of a discussion of the concepts related to each program type, a sample of representative commercially available programs, and a list of references for more information.

SUMMARY OF EVALUATION USES OF MICROCOMPUTERS

Activities	Word Proc.	Data Bases	Test Develop.	Calc/ Stats	Graphic Present.	Telecom/ Network.
Proposals & Planning	X	X		X	X	X
Management	X	X		X		X
Data Collection		X	X			X
Data Analysis		X		X		X
Reporting	X				X	X

WORD PROCESSING

The main concept behind word processing is the notion of a document, that is, a letter, book chapter, entire report, proposal boiler plate, or any discrete body of textual information. The creation of such a document starts with the use of a keyboard, more or less like a standard typewriter, to enter the text into the word processing system. Formatting, editing, merging, and printing are the four things that a word processor has to offer in addition to simple typing of text.

Formatting

There are some features of word processors which help to arrange words on a page as a document is created. Formatting refers to the arrangements of the words themselves. Like a typewriter, a word processing program allows you to indent the first word of a paragraph or to tab the headings and subheadings of an outline. It is possible to automatically center headings. Whole blocks of text can be indented and single spaced. In fact, the spacing between lines can be altered by using the return key just like on a typewriter. In addition, some word processors allow automatic underlining, subscripts, and superscripts. Special features include the creation and editing of multi-columns of text or tabular information and the creating of footnotes.

Editing

Once text has been entered, extra letters, words, and so on, can be inserted or deleted without having to retype the surrounding text. The word processing program automatically rearranges the text to accomodate these changes. In fact, words, phrases, sentences, and whole blocks of text may also be moved from one part of the document to another if the order of things needs to be changed.

Another interesting feature of most word processing programs is the ability to search for a particular word, such as one that may have been consistently misspelled. With most word processors, it is possible to automatically replace one word with another one, such as the correct spelling of a misspelled word, wherever it occurs.

There are even programs called spelling checkers which are electronic dictionaries. They "look at" each word in a document and check to see if it matches the words in the dictionary. If not, the word is presented for a decision about its correctness. Still more sophisticated are programs that check for diction, style, and clear wording, such as the one being developed by Bell Laboratories.

Merging

Since word processed documents are stored electronically, it is usually possible to combine them in various ways. The simplest way is to attach one document to another. For example, the parts of a proposal that were created as separate documents can be linked with a standard institutional description and disclaimers without having to retype or cut and tape them into place. Whole letters may be built of smaller blocks selected from a variety of paragraphs that provide different options for reporting results to various audiences. Old text may also be merged with new text as when a standard letter is customized by adding a unique beginning and ending, or by searching and replacing a symbol (such as "**") with the name of a particular person. In this way, names, addresses and text can be merged to produce personalized form letters.

Blank forms, such as activity logs, can also be created and stored. They may be retrieved and completed for individual events and then stored again. At the end of a project, the logs may be printed to document the activities which took place.

Printing

Some of the formatting features described above may have already set the general layout of a page, but with many word processors, final choices are made at the time of printing as to where the text is to appear on the printed page.

The first concept here is margin, that is, the blank space at the top, bottom, left, and right of the words. In most word processing programs, the margins are set at values which are used most commonly (for example, letters or manuscripts), and only make changes for special cases (for example, outlines). When printing a document, one must also decide if the text is to be right justified, that is, whether the words are to line up on the right side of the page in a straight line as they do on the left side of the page.

Headers and footers which do not appear in the text may be added at the time of printing. Page numbers may also be added automatically at the top or bottom of the page by the program as the document is being printed.

Spacing between the lines of text is often chosen at the time of printing (i.e., single space, double space). It is also possible to adjust the number of lines of text on a page, or to put it another way, to decide where each page stops, so that there are no widows or orphans at the top or bottom of a page.

In summary, word processing programs provide flexibility in the organization of text from its initial typing, to editing, to merging with other text, to printing.

A Sampler of Word Processing Programs

The programs presented in the following table are just a sample of the nearly 100 word processing programs available. There are many competitors, especially at the middle and upper price ranges. The articles in the reference list provide detailed evaluations of programs in terms of their specific features.

Program	Company	Cost	System	Comments
Bank Street Writer	Bruderbund	$70	Apple	The Volkswagon of word processing programs. This menu-driven program is ideal for draft production and other everyday uses.
Pie Writer	Hayden	$150	Apple	Has many features of more sophisticated programs, but it takes some practice to be able to use them all.
Electric Pencil	IJG Computer Services	$86	TRS-80	Like Pie Write, a good low-cost system. This one for TRS-80 machines.
WordStar	Micro Pro	$495	CP/M IBM	The top of the line program with most of the features of professional word processors.

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DATA BASE MANAGEMENT

A microcomputer data base may be thought of as an electronic filing system. Like a paper filing system, a data base consists of a consistent set of records. Each record is a completed form and on each page of the form there is specific information. The items of information on the page are called fields. For example, the first page of a student data base might have fields which contain an identification number, the student's last name, first name and middle initial, the student's grade, teacher, and school, sex and racial data, and any other demographic information needed. The second page of a student data base may have a set of test scores over a number of years. The third page may have parent information, such as parents' names, work and home addresses, and so forth. Together, the completed pages of this form make up one student record, and all of the student records created using this form constitute a file.

Let's look at the general characteristics of data base management programs.

Function:	Facilitates the storage, retrieval, and reporting of information
Programs:	VisiFile, DB Master, dBase II
Advantages:	Handles many kinds of information Very flexible - can be used to create many different files (e.g., student records, personnel records, equipment inventories) Easy to maintain information by editing, deleting, updating, sorting, and indexing records Can be used to retrieve information about individual records or about groups of records meeting certain criteria
Disadvantages:	Requires considerable time to set up Requires time to learn the operation of the more complex programs Limited statistical analysis Requires trained personnel to maintain the data base

There are three sets of concepts related to data base management that will help you understand what data bases are and what they do. One set concerns setting up a file. Another set has to do with how to use a data base management system. And the third set concerns generating reports.

Setting up a file

There is a considerable amount of planning that has to be done so that (1) the creation of a data base can be accomplished in an efficient manner and (2) the data base will have maximum utility. The first step is to decide how the file is to be organized; that is, what the primary key is to be. The primary key has the same relationship to a data base that a main entry card catalog has to a library. The "records" in the library are organized by some shelf location code. This code consists of an indicator for the subject area, a code for author's last name, the publication date, a title code, the copy number, and so forth, until that "record" is uniquely identified. Similarly, the primary key is a code for each record in a data base. It may be as simple as a Social Security number or it may be more complex and, for example, consist of last name, first name, and birth date.

It is often the case that records are not entered in primary key order. For example, the students in grade one may be entered after the students in grade five, even though their identification numbers come earlier in the sequence. The primary key is used by the program to find each record. The shorter the key, the quicker the program will be able to operate. Of course, there are many ways to organize the records in a data base. In fact, they may be sorted according to any of the fields in a record. These other organizations are called secondary keys and are very helpful if the user wishes to review a group of records organized in a particular way, say, by zip code and in alphabetical order by parent's last name.

Once the primary key has been established, the next step is to lay out the rest of the fields in a record. These can be alphabetic, numeric, or special fields, such as yes/no, social security, telephone, date, and so on. The fields or a record should be organized into logical sets and may be allocated to separate pages if necessary. The final step in creating a data base is to determine the format which will insure its utility.

In many cases the data base will be created as you specify the fields on each page of the form. Therefore, it is important to have a good idea of the physical layout of the screen pages, the basic characteristics of each field (i.e., the type of information and the amount of space to be allocated to it in the data base), and the special characteristics of each field (e.g., primary key, computed). Then you can follow the program directions on the actual setting up of the data base.

Using a data base

Once a file has been created it may be put to many uses. The initial use is to add records. When this choice is made, the program will typically display a blank first page of the data base form. The user simply begins entering the information field by field. Let's look at a couple of ways to save time when entering information into a data base.

There are times when you will not want to enter all of the information in a data base at once. An example might be when the test scores from the second year of a five-year program are ready. It would be a waste of time to have to move page-by-page and field-by-field through a form to get to the appropriate place. Instead, it is possible to extract just those fields needed to identify each record (i.e., the primary key) and those fields that need to be changed and to put them together into an abbreviated form. When data are entered and saved, they are inserted into their proper place in the larger record.

Another way to speed data entry is to use default values. These can be specified at the time when the data base is first created. Default values are those that will be used again and again, for example, a particular telephone area code. In other cases, temporary default values might be specified when a set of records are being added, for example, all of the reading scores for the third-graders in Crest Drive School. A good data base management program will facilitate the entry of data by allowing you flexibility in formatting the pages in your form, by giving you the option of creating short forms, and by providing you with the ability to set both permanent and temporary defaults.

After records have been entered, it is then possible to search for a particular record or a given set of records. In some programs, an extensive list of options for searching the data base is available. For example, you may wish to search for records which fall within a certain range such as Aa to Cz. Or there may be a need to find all of the records which start with a particular prefix, such as NWRELXXXXX. Sometimes records with a particular string of letters or numbers are desired, as in a search for all of the materials which include the word microcomputer. When the exact spelling of a word is not known, a search can be conducted which will find any word that has all the letters except the unknown ones (e.g., GR?Y). All of the relational signs can also be used to direct a search, including: =, <, >, and their various combinations.

Often these different types of searches can be linked together by an AND or an OR condition. For example, you might want to specify two discontinuous ranges. In this case you would simply indicate the first range and then link it to the next one with an OR statement.

Having found an individual or group of records, it is then possible to edit or delete them. Deleting simply removes the record from the data base. Of course, you must be sure that you want the record deleted. It is often a good idea to have archive files of old versions of a data base with records that have since been deleted, just in case you wish to retrieve them at some later date.

Editing a record means correcting, updating, or adding information. Using a short form is a convenient way to edit records. For example, a short form that just has grade level, new classroom assignment, and end of the year test scores can be used to quickly update student records. Often you may want to send the edited record directly to a printer so that you have a typed copy. There are, however, more sophisticated ways to print out the infomation in a data base.

Printing Reports

Generating an interesting and informative report is one of the most exciting and rewarding uses of a data base management system. There are four different formats that have to be specified in creating a report, namely, page format, data format, sort format, and select format. They form the column headings for the following table with their respective sub-formats falling under each heading.

Page Format	Data Format	Sort Format	Select Format
page numbering	comment lines	sort fields	record chacteristics
report dating	column titles	subtotal break fields	(range, includes,
lines/page	computed fields	page break fields	starts with,
continuous/ single sheet	data fields	(column totals)	relationals,
lines between records	comment fields		AND / OR conditions)
labels	horizontal sub- & grand totals		
	record numbering		
	code fields		
	report width		

Creating a good report takes as much planning as setting up the data base to begin with, but once it is created you can use it and/or its parts again and again.

Summary

Data base management packages are one of the more useful tools available in the microcomputer toolbox. A good strategy for developing an understanding of how these programs work is to start with a simple one like VisiFile or PFS File. As you gain experience in designing more demanding data base applications, you will outgrow these programs and look for a package with the extended capabilities you now need.

To design an application, try the following process:

1. Determine your goals. Be clear about what you want to accomplish with the data base.

2. Specify the data needed. Sketch the types of reports you expect from the data base. Develop a list of needed fields. Consider the requirements of each field.

3. Design the reports. Refine the sketches of reports and layout on graph paper.

4. Set up the data base. Enter the data base as you have designed it. Enter some sample cases and format some simple reports.

5. Revise. Learning from your initial mistakes, start over with an improved design. Repeat as necessary. Now format the standard reports you designed.

6. Pilot test. Use the data base on real data for a period of time. Manually confirm that the results are correct. Plan on revising again.

Three planning aids are attached at the end of this section: data base planning checklist, data base estimation worksheet, and a summary of software specifications.

Available Software

There are perhaps a hundred different data base management programs available on the market, ranging in price from ten dollars to over a thousand. Obviously, all data base programs are not created equal. It is useful to distinguish between three types of programs: file management programs, true data base systems, and text-oriented data base programs.

File management programs can only access information from a single file at a time. This is fine for a simple mailing list but not for an accounting system that must keep vendor information in one file and detailed information about specific orders in another. These programs are typically easy to learn and use but are limited in the amount or type of information they can store.

On large mainframe computers, data base programs must be able to access the information you want, even if the data are maintained in different files. For example, the request "please list the addresses of students who were in Chapter 1 last year and scored below the 35th percentile" would require data from an address file, a Chapter 1 participation file, and a test score file.

File management and data base programs usually limit the size of a field to less than 256 characters or the record to less than 1000 characters. That is adequate for most applications, but not if more than a sentence is required for any one field. A text-oriented data base allows fields to be a single word or a whole page. It is usually possible to search the data base on key words. These data bases are well suited for maintaining research notes, observations of students or staff, or bibliographies.

Some popular programs include:

Program	Vendor	Cost	System*	Type	Comments
Visifile	VisiCorp	$250	Apple	file management	easy to use but limited capabilities
PFS File PFS Report	Software Publishing	$125	Apple IBM	file management	easy but limited, need both programs
DBMaster	Stoneware	$230	Apple IBM	file management	many features but a little difficult and tedious to use
Infostar	MicroPro	$500	CP/M IBM	features of both	sophisticated data entry and report generation features
dBASE II	Ashton-Tate	$700	CP/M IBM	database management	great flexibility with built-in language, programming skills recommended
Datafax	Link Systems	$250	Apple IBM	text oriented	easy to use, free form input like a manual filing system

* Apples and certain other microcomputers can run CP/M software with the addition of a special circuit board.

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DATABASE PLANNING CHECKLIST

Task	Person Responsible	Deadline
Determine goals of system	(users)	
Identify desired reports or querys	(users)	
Identify necessary data items	(users)	
Identify data sources	(users)	
Select hardware and software	(developer)	
Develop database and reports	(developer)	
Conduct pilot test	(users)	
Refine database system	(developer)	

SCOPE OF DATA BASE
ESTIMATION WORKSHEET

	NAME OF FIELD	SIZE OF FIELD (# chars)	COMMENTS
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

(1)	Total characters per record (Sum of size of fields)			____
(2)	Anticipated number of records		____	
(3)	Additional records anticipated over life of data base		____	
(4)	Total records (line 2 + line 3)			____
(5)	Total characters (line 1 X line 4)			____
(6)	Data base housekeeping (line 5 X 1.5)			____
(7)	Total size of data base (line 5 + line 6)			| |

NOTE: This is only a rough estimate of the actual size of a data base since accurate figures will depend on the software used and the number and length of key fields, etc.

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SOFTWARE SPECIFICATIONS

Manipulating records

- Edit and delete records
- Select on more than one field
  - both pretest and posttest are greater than 0
  - served in that subject matter
- Sort or index on more than one field (e.g. school, grade)

Report characteristics

- Should allow summary only report
  - student counts
  - totals and averages
- Should provide for two or more breaks (school, grade)
- Summary statistics would be nice
  - totals and subtotals
  - count, means, standard deviations
  - crosstabulations, frequencies
- Table lookup for labels to codes or score conversion
- Allow calculated fields (e.g. gains, days served)

Maintaining database

- Reorganize or restructure (e.g. add a field)
- Automatic update (e.g. grade)

Database capacity

- Number of records
- Number and length of fields

ELECTRONIC SPREADSHEETS

Some say that the electronic spreadsheet in the form of the first VisiCalc program is what started the microcomputer revolution, and particularly the Apple computer. With this very basic tool, a microcomputer can be used to do anything that it is possible to do by hand using a multi-column ledger page. For example, spreadsheet programs can be used to:

> prepare a budget, make an income tax projection, calculate cash flow, do cost analyses, determine overhead allocations, generate sensitivity analyses, calculate weighted averages, prepare statistical summaries, analyze survey results, prepare bid specifications, keep track of study participants, and more.

In a few short years spreadsheets have grown from not much more than electronic ledgers to programs that include present value function, linear programming, and calculus functions. They also are likely to be able to read data from files created by other programs, such as accounting applications or data bases.

Integrated programs are often build around a sophisticated spreadsheet. One form of integration is the program that includes spreadsheet, graphics, and word processing programs all in one super program. Examples of this type of program are MBA (Context Management System; Torrance, CA), and 1-2-3 (Lotus Development; Cambridge, MA). Companies like VisiCorp provide compatibility among the different programs in their line, such as VisiCalc, VisiFile, and VisiPlot so that data can be shared among these separate programs. A new development is the integration of spreadsheet and data base management programs such as LogiCalc (Software Products Int'l; San Diego, CA). In trying to decide among different approaches to integration, one must consider both the quality of the individual programs and the ease with which data can be transfered.

Examples

The examples on the next several pages illustrate what the VisiCalc program can do.

WHAT CAN VISICALC DO?

CALCULATIONS

Like a calculator, VisiCalc excels at performing calulations (adding, subtracting, multiplying, dividing). In the example below, someone enters the number of students participating in a Chapter I progrm in the shaded area. The VisiCalc worksheet totals the number of students at each grade and in each subject area.

NUMBER OF CHAPTER I STUDENTS

Grade	Read	Math	Total
2			0
3			0
4			0
Total	0	0	0

NUMBER OF CHAPTER I STUDENTS

Grade	Read	Math	Total
2	23	14	37
3	35	27	42
4	25	23	48
Total	83	64	147

RECALCULATION

Unlike a calculator, VisiCalc can easily recalculate the results when any value is changed. In the example below, we reduce the FTE for Denison to try to reduce the project total to a more reasonable figure. VisiCalc immediately recalculates the totals using the new value for FTE.

PROJECT STAFF BUDGET

Staff	FTE	Salary	Benefit	Total
Jones				5670
Denison				15270
Williams				5670
Clark				16680
Faddis				15270
Total Salaries and Benefits				58560

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PROJECT STAFF BUDGET

Staff	FTE	Salary	Benefit	Total
Jones	.5	9450	1890	5670
Denison	[redacted]	12725	2545	7735
Williams	.5	9450	1890	5670
Clark	1.0	13900	2780	16680
Faddis	1.0	12725	2545	15270
Total Salaries and Benefits				51025

TABLE LOOKUP

Often we have to look up values in a table (e.g. test score, salaries, bonus points) before doing a computation. VisiCalc can do the table lookup for us. In the example, we enter a code and the worksheet looks up the proper points and computes the total.

Activity	Bonus code	Bonus points
Books read	1	10
Participation	2	20
Extra report	3	40

Student	Test Hawk	Bonus code	Total
Janice A	[redacted]		87
Dennis B			104
James B			44
.			
.			

DATA STORAGE

Information can be stored on floppy disks for later use. In the example below, program expenditures are added to a VisiCalc template each month. The computer recomputes the Year-To-Date Expenditures and Percent of Budget Expended.

PROGRAM EXPENDITURES COMPARED TO BUDGET

Act #	Account	Budget	YTD Expend	% of Budget	SEP	OCT	DEC	JAN
100	Salaries	56000	14000	25	[redacted]			
200	Benefits	14500	3625	25				
300	Pch serv	1200	800	67				
400	Supplies	1800	2100	117				
500	Outlay		0	0				
600	Other		0	0				

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LOGICAL DECISIONS

Often we want to do a computation only if some condition is true. For example, we will consider students eligible for a special program only if their test score or grade point is above or below some criterion. The worksheet below marks a student as eligible for Chapter I services only if the test score is below the cutoff.

Chapter I Student Selection Worksheet

Cutoff on test: Reading 35
Math 39

Student	Read Score	Math Score	Reading Eligible	Math Eligible
Janice A	[redacted]	[redacted]	*	
Dennis B				*
James B			*	*
.				
.				

SIMPLE GRAPHICS

Do you ever tire of reading tables of numbers? VisiCalc can help by constructing simple bar graphs. Here we enter numbers in a graphing worksheet which rescales and displays the results.

MIGRANT STUDENT ENROLLMENT BY MONTH

Month	Enrollment
Sept	[redacted] *********
Oct	**********
Nov	******
Dec	**
Jan	**
Feb	**
Mar	*****
Apr	**********
May	**********

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Advanced Spreadsheet Features

Recent spreadsheet programs provide extended features that are not available with the original VisiCalc. The table below suggests some features to look for in the new generation of spreadsheet programs such as Multiplan, SuperCalc2, and Advanced VisiCalc.

Feature	Description
Consolidation	Allows worksheets to be linked together (e.g., Years Summary worksheet accesses totals from 12 Months Summary worksheets). Makes the spreadsheet seem three-dimensional.
Sort	Allows the rows or columns to be sorted in numeric or alphabetic order (e.g., reorder list of students from lowest test score to highest for selection purposes).
Execute	Executes a series of commands from a command file that you have created (e.g., load a worksheet, print the results, change a value, print the new results).

Spreadsheet Program Sampler

Program	System	Comments
VisiCalc	Apple II TRS-80 II, III Atari Commodore Pet IBM	The first spreadsheet program, very popular.
Advanced VisiCalc	Apple III	Includes a number of advanced features over VisiCalc.
SuperCalc	CP/M IBM	Similar to VisiCalc with some minor improvements
Multiplan	CP/M IBM	Called software package of the year by Infoworld magazine

Note: CP/M stands for microcomputers using the CP/M operating system, (Control Program for Microcomputers). Most business-oriented microcomputers, such as TRS-80 Model II, NorthStar Advantage, DEC Rainbow, Osborne I, and Xerox 820 fall into this category. Also note that an Apple II with a Z80 softcard can use CP/M software.

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Heintz, C. Seeking solutions with spreadsheets. Interface Age, September 1983, 52; 54-590; 167.

Immel, A. R. Software's new crossroads. Popular Computing, October 1983, 48; 50; 52; 54.

User Groups

SATN (Software Arts Technical Notes). The Journal for VisiCalc Users, Software Arts, Inc., P.O. Box 815, Quincy, MA 02169.

S P R E A D S H E E T. VisiGroup, P.O. Box 1010, Scarsdale, N.Y. 10583.

SPECIAL USES OF MICROCOMPUTERS IN EVALUATION AND ASSESSMENT

Traditionally, evaluation and assessment projects have relied on mainframe computer services to accomplish many of their tasks. Reductions in the price of microcomputers and dramatic increases in their power, that is, their memory and speed, make microcomputers increasingly attractive for use for evaluation purposes.

There are many uses for such generic tools as word processing, data base management, spreadsheet, and telecommunications programs. However, there are three special types of software that are especially relevant to evaluation and assessment efforts.

Instrument Generation

A good instrument generation program should have the following characteristics:

- easy text entry and editing for item creation and modification
- convenient and safe data storage so that items can be quickly manipulated and reliably saved
- simple item retrieval to facilitate the development of a complete instrument
- flexible printing options for generating instruments, including last-minute editing of items, as well as the creation of headings and special directions

Text Entry

Flexibility in text entry is the key characteristic that a program needs in order to ease the task of developing items. A good program will allow both immediate modification of items and modification subsequent to their creation. Modification might include altering an item by:

- inserting or deleting material
- reformatting
- adding options (i.e., responses)
- changing the item's descriptors

These characters facilitate the continuing improvement of items throughout the life of an item bank.

Another important aspect of flexible text entry is the variety of item formats that are allowed. For example, programs differ in their ability to handle true/false, multiple choice, matching, fill-in-the-blank, or essay items.

In addition to item type, the provisions made by a program for the inclusion of pictorial material is one that must be considered if such material is critical to the nature of an item. Pictures, diagrams, formulas with subscripts and superscripts, and special symbols are almost impossible to save in machine-readable format. About the only ways to overcome this limitation are (1) for a program to allow one to add a reminder to an item that pictorial material is to be included at the time of printing, and (2) for the program to allow designation of the number of line feeds to follow an item so that room is provided for the material.

Item Storage and Manipulation

Safe item storage is related to a program's ability to verify new material before it is written to disk and to check before items are saved to insure that another set with the same name is not inadvertently destroyed.

There are two ways to handle the storage and manipulation of test items. One way is to allow the creation of a large number of items, limited only by the capacity of the auxiliary storage medium, such as floppy disk drive. In this case, items are manipulated by transferring as many as possible to random access memory (RAM) and gradually working through the item bank. The drawback here is the time needed to transfer items back and forth from auxiliary storage to RAM.

The other way to store and manipulate items is to limit each file to as many items as will fit in RAM at one time. This makes for faster manipulation of a given set, but, of course, the set is smaller than a file whose size is related to disk capacity. And, if items from separate sets scattered throughout a disk are to be manipulated, then the task can be even more time consuming than a similar task performed with a program which is based around disk storage limits.

Some programs that are RAM based provide for the merging of subfiles into larger units, and for breaking bigger files into smaller ones. This can facilitate the task of manipulating a given set of items.

Item Retrieval

The simplest method of retrieving items is to assign each one a number as it is created. Then, using a master printout, one can locate and call up each item by its number in response to a prompt provided by the program. Another way is to be able to display items on the screen in numeric order and to be able to press a single key to identify an item to be selected. For large item banks, the use of item descriptors can help to narrow down the number of items to be reviewed in order to identify those to be selected. For example, descriptors might refer to (1) type of item (i.e., item format), (2) subject matter, or (3) classification in relation to a taxonomy (e.g., Bloom's taxonomy).

In some programs, the answer line can be used not only for storing the specific answer to an item, but also for information that can be used to help find items. For example, the following might be stored in the answer line:

> key words in an essay, notes to oneself or any alphanumeric information, or if the items are based on a set of objectives, the abbreviated name or number of the objective tested by the item.

Another piece of information that would be useful in retrieving appropriate items for a given instrument is an indication of item difficulty. This could be accomplished by simply placing in the answer line a rating of "easy," moderate," or "hard." A more sophisticated method would be the ability to include both difficulty and discrimination indexes for all item alternatives. Using a sort routine, items could then be selected on index values, as well as information on content, format, and other characteristics.

This inclusion of specific information useful for item retrieval adds a whole new dimension to instrument-generation programs.

Printing

Once items are retrieved from the bank for a particular application, it is helpful if they can be edited to tailor them to that setting. It would also be useful to have the option of saving the edited items in a separate file for later use. In any case, the original set of items in the item bank itself should not be permanently altered by these last-minute modifications. This is especially important if the item bank is intended to be generic; for example, if it is a set of essay items on current events where the details of the items are to be added in relation to the latest happenings.

In addition to editing capabilities, a useful program will allow one to format an instrument to a particular situation. Using special headings or titles is one way to accomplish this. Being able to tailor the instructions can greatly improve the utility of an item bank, too. The capability to determine left and right margins, to determine the number of lines of print and total numbers of lines per page, to require a pause after each page is printed, and to print all or just part of a test are all program print features that can help improve the face validity of an instrument.

Summary

Programs exhibit these characteristics to varying degrees. Trying different programs is the only way to determine if the features you need are included and readily usable.

Instrument Generation Sampler

Program/Company	Cost	System	Comments
Author I Radio Shack Education Division	$150	TRS-80 I/III	Test assembly, on-line testing, and the development of student records/profiles are features of this program
The Learning System, Microlab Highland Park, Illinois	$150	Apple	On-line testing of items from a program item bank, class statistics and student profiles are all part of this program.
Test Bank 2.1 Advanced Technology Applications San Diego, CA	$450	TRS-80 I/III	Flexible text entry, item editing, test preparation are just some of the features of this program
Teacher Utilities Vol. 1 Minnesota Educational Computing Consortium (MECC)	$37	Apple II	Item files, on-line testing, test assembly, test printing, plus class statistics and grades are features of this program.

Data Collection and Test Scoring

Two of the most time-consuming and tedious aspects of evaluation and assessment are the collection of data in the field and the scoring of tests and other instruments. Microcomputer based data entry systems have a variety of purposes which are consistent with the needs of evaluation and assessment projects, including stimulus control, prompting, encoding, quality control, and speed of entry.

The purpose of computer based data entry systems may be accomplished by several different approaches. The following table lists five different approaches to data entry, relates them to the aforementioned purposes, and provides additional information about each approach.

COMPARISON OF APPROACHES TO COMPUTER-AIDED DATA ENTRY

Type	Description	Data Entry Person	Primary Purposes	Example	Typical Software
Individualized	Answer questions on screen	respondent	stimulus control quality control	Surveys, individually administered achievement tests	Custom program in BASIC or authoring language like PILOT
Field based	Respond to prompts on screen	interviewer/ observer	stimulus control encoding quality control	Observations or interview	Custom program
Forms oriented	Enter data into form on screen	secretary/ clerk	quality control prompting	Recordkeeping, student info.	Data entry programs, data base management
Batch oriented	Enter data line at a time with little interaction with computer	keypunch operator	speed	Test or survey item data	Data entry programs
Optical scanning	Process forms with mark sense reader	clerk	speed	Test or survey item data	Data Entry programs

One way to enter data efficiently is through the use of optical scanners. These readers come in three varieties related to the format of the form used to record information. A sample of types and producers includes:

Card Reader	Partial Page	Full Page
Chatsworth	Scantron	NCS Sentry 3000
HEI		Scantron
Mountain Computer		

This technology is relatively new for the microcomputer. Prices are continually decreasing and features are being added. For the next five years, there will be a real increase in the availability and utility of such devices.

Sampler of Data Collection and Test Scoring Programs

Program/Company	Cost	System	Comments
Score: The Academic Assistant Scientific Software Wausau, WI (414) 845-2066		Apple	This program includes on-line testing and test scoring as well as grade profile and item analysis features.
T.E.S.T. K-12 Micromedia Valley Cottage, New York	$25	TRS-80	On-line testing based on program generated tests, made up of items from an item bank are all features of this program.
Multiple Choice Tests Educational Courseware Westport, CN	$36	Apple II	Item file, on-line testing and test printing are features of this program

Statistical Analysis

At the heart of all evaluation and assessment efforts is the analysis of data. Statistical analysis programs on main-frame computers have provided the main statistical source of support over the last 25 years. Accessibility to mainframe systems and their steadily increasing costs, together with the rapid advance of mini- and microcomputer technology, has begun to change that picture! Recently microcomputer based programs, ranging in price from $20-$2,000 have become available. Of course, they vary greatly in their features.

There are 5 sets of features that should be examined when considering the purchase of a microcomputer based statistics program. The first is documentation. This includes the written information about how to use the program and about the technical aspects of the program. The second feature is data management, including data entry and editing. The third feature concerns the statistical manipulation of data in terms of descriptive and inferential statistical procedures. A fourth feature is the printing of information. Included here is the simple printing of raw data and the generation of complete reports. There is a fifth, general feature which might be termed special capabilities, such as the availability of a random sampler and

the extent to which the program can be configured to a particular system. Each of these features is examined in more detail in the following discussion.

Written Information

The documentation for a program can be a major factor in facilitating or hampering its use. Good documentation for statistical software will at least provide some description of (1) the way the software is organized, (2) some basic information about each feature of the program, and (3) more detailed information about the statistical procedures and when different procedures might be selected. Welcome additions are a set of examples on a tutorial to show how to use each program feature and the results obtained, and examples showing what printed versions of the results will look like from a simple printing of cases to finished reports.

Exemplary documentation will include the particular algorithm used in each analysis so that the user can be fully aware of its assumptions. The best documentation will also provide instructions for modifying formulas to better meet particular situations.

Data Management

Data management starts with the entry of data into the program. Some programs provide the option of entering data either directly from the keyboard or from a data disk.

A very elementary question to ask about a statistical program is what kind and how much data can it handle? For example, can one enter integer, alphanumeric and/or decimal data? And what is the total number of variables and the number of cases that are possible?

Two data entry procedures exist, case-by-case entry, where all variables for each case are entered at the same time, and variable-by-variable entry, where all cases for each variable are entered as a group. Better programs give you a choice between these two procedures.

If it is possible to enter data from another disk, one must know if data from a data disk needs to be formatted in a way unique to the program, or if data formatted in a standard way, such as DIF files, are acceptable. If DIF files are acceptable, then data can be shared with such programs as VisiCalc and DB Master. It is also important to know if data are stored in sequential files or random access files, and if conversions are possible, because of the different ways these files are accessed.

Once data are in the program, there should be procedures for maintaining them. At a basic level, maintenance includes adding new data, correcting erroneous data, and deleting unnecessary data. There are some programs which allow transformations by constants, exponentials, ranking, and so on. Being able to add new data can help to make a statistical program more like a data base management program, since the features can be used to build a record regarding a given case or a particular variable.

Statistical Procedures

Programs vary in the range of statistical procedures they include and in the variety of procedures regarding any one type. The following list is a sample of the range and variety of procedures that may be offered:

Descriptive Statistics
- Frequency
- Mean
- Median
- Mode
- Range
- Standard deviation

Measures of Relationship
- Correlation (e.g., Pearson product-moment correlation co-efficient)
- Contingency tables/cross-tabs
- Linear regression

Distributions used in statistical Inference
- Normal
- Chi
- F
- t

Analysis of Variance (ANOVA)

- One Way (Fixed effects)
  - equal N's
  - unequal N's
- Two Way (Fixed effects)
  - equal N's
  - unequal N's
- One way and multifactor analysis of variance
  - randomized designs
  - factorial designs
  - split-plot (mixed) designs

Not all programs contain all types of procedures, and some include different specific procedures within a type. Therefore, it is especially important to examine statistical packages in light of your specific needs and preferences before purchase.

Printing

There are times throughout the process of using a statistical program that printing may be desired. When data are being entered, for example, one may wish to get a printed case-by-case or variable-by-variable summary in order to verify the accuracy of the data. Printed results of computations, especially of intermediate processes such as a regression equation, which may be used in other computations, can be helpful. And, of course, the results of analysis should be printable in a format that is consistent with conventions (e.g., contingency table, ANOVA table) and should be clearly labeled so that one can easily interpret them.

Beyond the printing of individual results, it is often useful to present a graphic picture in the form of scatter plot, histogram, and so on. These may then be combined with the results of analysis to form a report. For example, a report summarizing an item analysis might have the following information:

- item analyzed
- number of respondents
  - number checked
  - number selected
- number selecting each response
- percentage selected regarding this response
- percentage answering this response
- totals for each of the above
- no answers
- median value
- average value
- standard deviation
- a histogram of responses

When looking at report generation features, one should seek the kind of flexibility offered by the best data base management and survey development programs. That is, a program should allow control over (1) placing headings and footnotes on a page, (2) formatting the arrangement of textual and other information, and (3) storing completed reports for later use.

Sampler of Statistical Analysis Programs

The listing of computer statistical aids which appear at the end of this section summarize some of the current programs. It is vitally important to review first-hand any of the programs listed in this section. In fact, a good way to find a reliable vendor is to inquire about preview privileges and technical support. A

30-day trial period to assess the quality of a program should be allowed before making a final decision. During that time frequent interaction with either the local dealer or developer will indicate the quality of support available.

With this experience, you and your staff can gain confidence in the performance of a piece of software and in the technical support available as backup.

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Lippey, G. (Ed.) Computer-assisted test construction. Educational Technology Publications, Englewood Cliffs, NJ, 1974.

The American Statistician, February 1983, 37(1), 83-86.

A LISTING OF MICROCOMPUTER STATISTICAL AIDS

The listings below have been adapted from The American Statistician, Feb. 1983, Vol. 37, No. 1, pp. 83-86. (NK = "Not Known".)

Package Name & Aprx.$	Vendor	Description	Language and System
Abstat $395	Anderson-Bell 5336 S. Crocker Littleton, CO 80120	Data Manipulation editing, regression, ANOVA, Cross-tab, chi-sq, histograms, plots, descriptive, tests, others	NK CP/M IBM
AIDA $235	Action-Resrch. Northwest 11442 Marine View Dr. SW Seattle, WA 98146	Histograms, ANOVA descriptive, bivariate multivariate, tests correlations, regression, plots, transformation, weighting	Basic Apple
A.STAT $125	Rosen Grandon Assoc. 296 Peter Green Road, Tolland, CN 06084	Transformations, descriptive, frequencies, tables, regression	Basic CP/M Apple PET
Curve Fitter $35	Interactive Microware, Inc. PO Box 771 Dept. SK State College PA 16801	Best fit, scales, average, smooth, interpolate, least squares	NK Apple
DAISY $80	Rainbow Computing, Inc. 19517 Business Center Drive, Northridge, CA 91324	Descriptive, regressions, transforms, tests, ANOVA, nonparametric, time series, modeling, plots	NK Apple
Dynacomp Reg-$119 ANOVA $119	Dynacomp, Inc. 1427 Monroe Ave Rochester, NY 14618	Regression, ANOVA	Basic Apple Atari TRS-80 PET
EdStat-Pac $20	Univ. of Mich., School of Education Ann Arbor, MI 48109	Descriptive, freqs., Chi-Square, ANOVA Two-Way ANOVA, nonparametric, regression correlation, Chronbach-Alpha	Basic Apple
Math-Stat $750	Mathematics Policy Research, Inc. P.O.Box 2393 Princeton, NJ 08540	Descriptive, cross-probability functions, correlation, ANOVA, regression, data management	IBM-PC CP/M
Micro-stat $325	Ecosoft PO Box 68602 Indianapolis Indiana 46268	Data Management transformation, descriptive, tests, ANOVA, plots, regression, time series, nonparametric, cross-tabs, distributions, chi-square	Basic CP/M IBM

Package Name & Aprx.$	Vendor	Description	Language and System
Scientific Plotter $25	Interactive Microwave, Inc. PO Box 771 Dept. SK State College, PA 16801	Draws X/Y graphs, 20 symbols, error bars	NK Apple
Speed Stat 1 $200-$250	Soft Corp International 229 Huber Village Blvd. Westerville, OH 43081	Freqs., crosstabs, correlations, descriptives	Assem/ Basic Apple
Statistics Pac $100	Creative Discount Software 256 S. Robertson, Ste 2156 Beverly Hills, CA 90211	Data Management, curve fitting, probability, general statistics	Basic TRS-80 Apple
STATPRO $1995	Wadsworth Electronic Publ. Co. 20 Park Plaza Boston, MA 02116	Database management, Descriptive, corr., Regress., extensive multi-variate, graphics time series, ANOVA	Pascal Apple IBM
STATPAK $500	Northwest Analytical Inc. PO Box 14430 Portland, OR 97214	File management, probability, descriptive, regression, nonparametric, distributions, tests, chi-squared, ANOVA plots, random numbers	Basic CP/M IBM
INTRO-STAT 2.2 $150	Ideal Systems P.O.Box 681 Fairfield, IA 522550	Descriptive, crosstabs, totals, Mann-Whitney t, Wilcoxon, 1-2-way ANOVA, 2 variable scatterplot, Pearson correlations, simple linear regression, data file management	Apple
THE STATISTICS SERIES	Human Systems Dynamics 9249 Reseda Blvd., Suite 107 Northridge, CA 91324		
ANOVA II $150		ANOVA, ANCOVA, many designs, 1 to 5 factors, 2 to 12 levels. All interactions, marginals, means, cells, plots	NK Apple IBM
HSD REGRESS $100		25 vars., 300 cases, predicted, residuals, plots	NK Apple IBM
STATS PLUS $200		General Statistics package, database management, nonparametrics, freqs., corr., t-tests, regressions	NK Apple IBM

GRAPHIC TOOLS

Pages and pages of reports. Who will read them? How can you spark the reader's interest? Some authors would argue that graphs and charts are the most effective way to communicate an idea. Most people hate tables of numbers and refuse to read more than a page or two of text. Rather, most people are visually oriented and can glean the basic message from a properly constructed graph.

Typically, we do not use graphics in our reports because we cannot afford a graphic artist and lack the necessary skills ourselves. However, the versatile microcomputer does have graphics capabilities.

Software

There are two basic types of software aids to graphing. Business graphics packages are designed to produce bar graphs, line graphs, and pie charts. The user enters the data values to be plotted and then selects the type of graph desired from a menu. The program automatically creates the graph on the screen and allows the user to change or dress it up before printing.

The second type, design or presentation graphics software, is more analogous to an artist's pallet and canvas. You draw lines, shapes, and colors on the screen and then edit them (shrink, expand, move). This type of graphics is not well suited for bar graphs, but its flexibility is perfect for diagrams, flowcharts, forms, and simple illustrations.

The choice of software will be greatly limited by the computers and printers each package supports. Other considerations include such features as options for inputting data, variety of graph types, and flexibility in editing the graph before printing.

Hardware

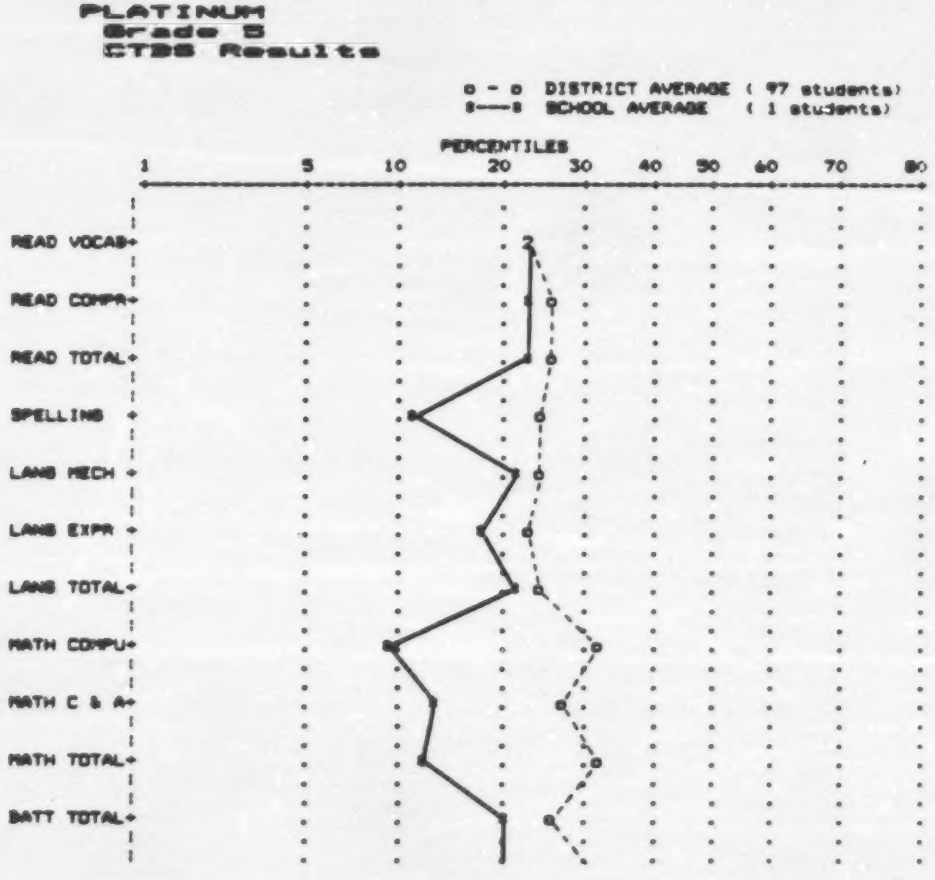
Will my Brand X microcomputer handle graphics? Perhaps. Obviously, the computer should be able to display graphics on the monitor screen, either in black and white, or color. While taken for granted with home computers designed for video games, this capability has been left out of most business microcomputers until recently. The resolution (or clarity) of graphics displays varies widely.

Actually, the real problem is getting the graph on paper. Until the last two years, most printers could handle only the simplest of graphics, and other printers were too expensive. Today there are a number of low-cost devices that can print graphics, though the visual quality still falls short of what a graphics artist could do.

The following examples illustrate three options for creating graphics.

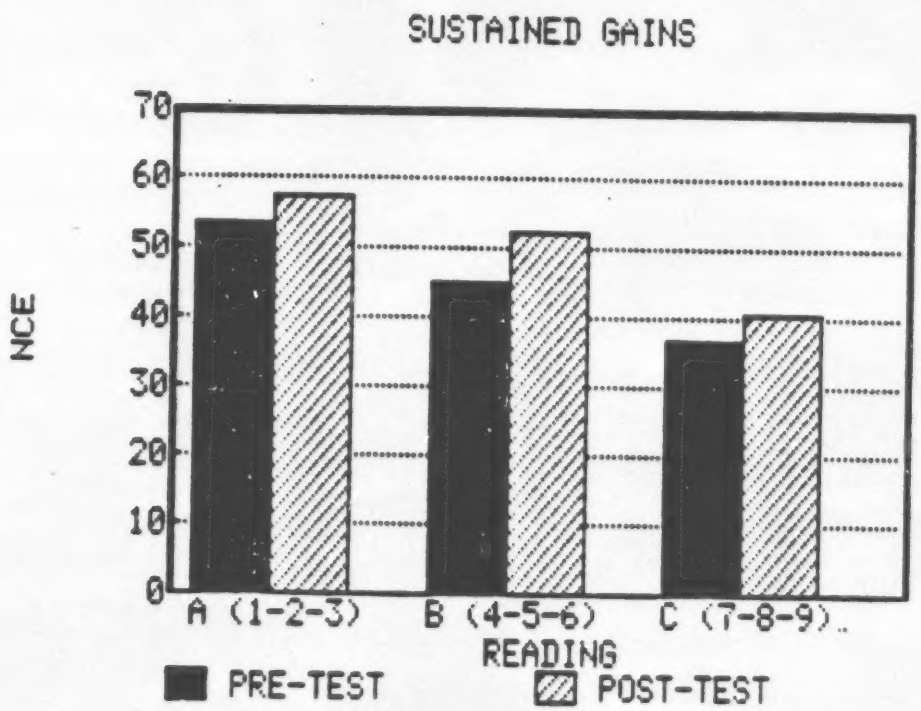
- Character graphics. Standard characters like *, /, and X are used to create a graph that can be output by any printer. The limited characters available usually result in poor visual quality. Figure 1 shows results that were plotted using character graphics. The connecting lines were drawn by hand.

Figure 1. School achievement profile using character graphics.



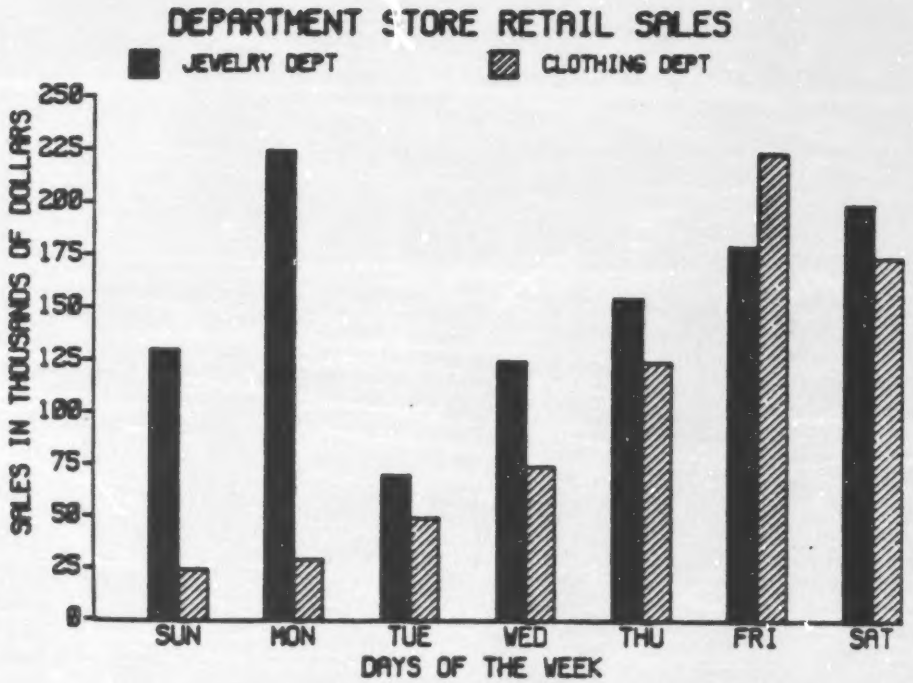
- Dot graphics. A dot matrix printer with a graphics option can produce graphs like Figure 2. The print head of a dot matrix printer consists of a row of pins which strike a carbon ribbon to form typewriter characters. With the proper software, the pins can be made to fire in any sequence to duplicate the shapes on the computer screen. The Prism by Integral Data Systems even has a multicolored ribbon to add color.

Figure 2. Bar graph of achievement gains using dot graphics.



- Plotter graphics. A specialized device called a plotter can be use to generate good quality graphs like Figure 3. The graph is drawn by a colored pen held by a mechanical arm that functions much like the human arm. Examples of low-cost plotters include the Hewlett-Packard 7470A, the Houston Instruments Hiplot DMP-29, and the Strobe Graphics Plotter. At $800-2000, these plotters are still rather expensive since a printer will still be needed for standard text.

Figure 3. Example of plotter graphics quality.



Sampler of Business Graphics Software

Package	Computer	Comments
APPLEPLOT	Apple II	Easy to use but fewer features than some
PFS: GRAPH	Apple II	Works with PFS: FILE
VISIPLOT	Apple II	Best suited to time-oriented data
Lotus 1-2-3	IBM	Combines graphics capability with spreadsheet and file management
GRAFTALK	CP/M	Supports a variety of printers and plotters, and terminals

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Bonner, P. Communicating with presentation graphics. Personal Computing, July 1983, 110-119.

Bowerman, R. Creative communication with computer graphics. Interface Age, October 1983, 68-69; 71-74; 160-168.

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COMMUNICATION TOOLS

Most people recognize that computers can communicate with other computers, but few people understand why this is important. Assume that you have test scores of a thousand students on a large computer and want to be able to analyze them on a small computer without re-entering the data; the computers must be able to exchange information even though the large computer may be miles away.

Currently the major applications of computer communications in evaluation are:

- Data communications - transferring data from large computers to small ones, transferring word processing documents between machines, transferring programs from one microcomputer to another.

- Remote data processing - use microcomputer as a terminal to control the analysis of data on large mainframe computers, using statistical software like SPSS.

- Online data base searching - access information utilities such as the Source, Dialog, and BRS to conduct bibliographic data bases maintained by those utilities. Two educational data bases are ERIC and RICE.

- Electronic message systems - Electronic mail systems, computer conferences, and electronic bulletin boards are examples of systems that allow other computers to call in and leave or receive messages.

There are several ways that communication may occur between computers, but we will focus on the most common form, telecommunications. Briefly, here is how it works. The computer is connected to a device called a modem which converts the electronic signal coming from the computer so that it may be sent over standard telephone lines. The modem at the other end translates the signal back to its original form and relays it to the computer. Thus, what you type at the keyboard is passed over the telephone line to the other computer and vice versa.

Software

The software tool used most frequently for telecommunications is known as a "terminal" program since the program essentially turns the microcomputer into a terminal (keyboard and display) hooked to a large computer. The main function of the program is to send characters typed at the keyboard out the cable to the modem and to interpret characters coming back from the modem. Some of the advanced features you should look for in a program are listed below.

Feature	Explanation
Transmission options	Allows you to set transmission rate, number of data bits, parity checking, duplex, and other characteristics of the transmission.
Log of session	Program records the messages sent or received in memory or to a file on the floppy disk.
File transfer	Accepts name of a file on the floppy disk, gets the file and sends it to the modem.
Block file transfer (Protocal file transfer)	Same as file transfer except that the file is sent in blocks with error checking. When transmission errors are detected, the block is re-sent. This mode requires the same program to be operating at both ends and uses special protocals or conventions for controlling the transmission.
Help	The program operation is explained on the screen when a help key is pressed.

A Sampler of Terminal Programs

Program	Computer	Comments
ASCII Express	Apple II	Many fine features.
Crosstalk	CP/M, IBM	Available for a variety of computers; many features, such as protocol file transfers.
LYNC	CP/M	Unique license is for the institution, not just for a single computer. Available for a variety of computers.
Omniterm	TRS-80, IBM	
ST-80	TRS-80	Many features, such as error detection
VisiTerm	Apple II	

Hardware

The main piece of hardware required for communications is the modem, the device which sends signals over the telephone line and translates the incoming messages. The primary characteristics to look for in a modem are:

Feature	Explanation
Speed	Most modems operate at 300 baud (30 characters per second), but this is quite slow, and we are seeing many 1200 baud (120 cps) modems using a standard known as Bell 212.
Coupler	Most modems have acoustic couplers, rubber cups into which the telephone handset is put. Others connect directly to the phone with a modular phone jack. Direct-connect modems have become increasingly popular.
Duplex (echoing)	Some computers display the characters you type on the screen immediately (half duplex) or wait until it is echoed back from the other computer (full duplex), thus confirming that the character was received all right. Full duplex is most common.
Dialing	Some direct connect modems can dial the telephone when the number is typed at the keyboard (autodial), and a few can answer the telephone when it rings (auto-answer).

The other piece of hardware needed is a serial port. The computer must have a way of transferring information out to the modem. This interface or port is usually known as an RS232 serial port. Most printers, in contrast, require a parallel port. Most business computers are sold with both ports, but others, such as the Apple II, need an additional circuit board.

A Sampler of Modems*

Company/Product (Price)	Computer	Comments
Hayes/ Smartmodem 300 ($289)	RS232C Interface	This auto-dialing, direct-connect modem is full duplex, with a variable baud rate of 110-300. Audio monitoring and self-testing are also features
MFJ/ MFJ-1232 ($129.95)	RS232C Interface; TTL/CMOS inputs/outputs	This acoustic coupler, full or half duplex modem has both 110 and 300 baud transmission rates. It may be connected to the Apple II game port, with MFJ-1231 software.
Novation/ D-CAI ($199)	RS232 Interface	This direct connect, auto-dialing modem is both full or half duplex with a 300 baud transmittion rate. It has a self-testing feature.

* From The, L. Data communications: A buyer's guide to modems and software. Personal Computing, March 1983, 102-103; 108-109.

Literacy

You should not find it difficult to learn the basic operation of a terminal program. You will want to add some communications jargon to your vocabulary, such as the following terms, so that you can better understand the telecommunication process.

ASCII — An acronym for American Standard Code for Information International Interchanges. This is the standard code for most communications.

baud — Measure of transmission speed, essentially means bits per second (bps).

bit — Contraction of "binary digit." A character is represented in the computer by eight bits.

bps — Bits per second, measure of transmission speed. Since each character transmitted requires about 10 bits, think of 300 bps as 30 characters per second.

full duplex	Transmission occurs in both directions and each character is echoed back to the originating computer.
half duplex	Transmission occurs in one direction at a time and characters are not echoed back to the originating computer.
modem	Contraction of "modulator-demodulator." Translates the signals between computers for transmission over telephone lines.
network	A system consisting of a number of stations that can interact.
parity	A simple error detection procedure which uses the eighth bit of each character to determine whether the sum of bits are even or odd.
protocol	A set of conventions or procedures governing data transmissions. The computers at each end must be using the same protocol or the transmission will fail.
RS232	An electrical standard for connecting equipment set by the Electronic Industries Association.

Some describe telecommunications as a "Black Art." Communicating between computers is relatively easy once the terminal programs have been installed and all the bugs worked out, but getting to that point can be extremely frustrating. Be sure that you have identified a consultant or vendor with communications skills.

Alternatives to Telecommunications

There are alternatives to the telephone for transferring information between computers. Local Area Networks link computers that are close in proximity so that they can share such information and peripherals as printers and hard disk drives. When the information transfer does not have to occur immediately, data can be moved using floppy disks as there are now programs which convert the format of a floppy disk from one computer to the format of another.

References

The, L. Data communications: A buyer's guide to modems and software. Personal Computing, March 1983, 96-103; 108-111; 114-117; 122-124; 127-128; 171; 173.

NETWORKING

A local area network is a coordinated system for communicating data. It is a system that lets computers, printers, disk drives, modems, and monitors interact with each other. A basic local area network (LAN) includes five components:

- the hardware, made up of computers and peripherals
- the network interface, typically an expansion card which plugs into the hardware
- the network master controller, either a chip on the expansion card, a hard disk drive, or a dedicated computer
- the network server, a hard disk drive that carries both the software for the LAN specifically and the programs available to network users
- the wiring to connect the parts of the network

The personal computer local networks most often used are made by Corvus systems, Inc. and Nestar Systems, Inc. Over 5,000 Corvus Constellation and Omninet networks, and nearly 1,000 Nestar Cluster/One and Plan--4,000 networks are currently in operation. These and some of the other more popular networks are described in the sampler of networks.

Two developments have helped to spread the use of local area networks. One is the change in the type of wiring which link together the components of a system. New cables (coaxial baseband wiring) have cut the cost of this important part of a network by two-thirds. They also transmit information far more quickly and may eventually be used to carry data, voice, and video messages simultaneously.

Another improvement is the way the network actually functions. The earliest systems used a star pattern, where the master controller (typically a hard disk drive) was located in the middle of "slave" terminals. The network distributed data from the center of the star along its arms to the terminal at each point. Communications were slow because everything had to be cleared and approved by the hard disk drive before it could proceed. But now a bus configuration is used where all of the hardware on the network issues instructions independently and the master controller simply directs the data traffic up and down the length of wiring.

As was noted in the article, Networking the Workplace, from which the information for this section was drawn:

> 'The beauty of networking personal computers as compared with using minicomputers or mainframes is that with the mini or mainframe, each time you add a user to the system--each time you install a new dumb terminal--you detract from the overall computing power of the system. You simply slow the system down,' says Jim Pritchett, president of Trinity Computing Systems in Houston, Texas, which sells LANs to large installations. 'With the personal computer, though, it is just the converse. You add power to your system each time you enhance the network. You are giving it more memory or providing another peripheral or adding more storage capacity.' (Rothfeder, 1983)

Sampler of Networks*

Program/Company (Cost)	Computers	Description
OMNINET Interface card, $495; Network file server (with 18-Mb drive), $4,385 Corvus System, Inc. 2029 O'Toole Avenue San Jose, CA 95131 (408) 946-7700	Corvus concept Apple II, IBM - PC DEC LSI-11 TI Professional	Omninet links up to 64 workstations over a maximum distance of 4000 feet using twisted-pair wiring. The computer and peripheral interface cards contain a transporter or network master controller chip. The software server is attached to a hard disk drive. Disparate computers on the network communicate with each other.
PLAN 4000 Interface card, $595; Network file server (with 60-MB drive), $22,700 Nestar Systems, Inc. 2585 E. Bayshore Rd. Palo Alto, CA 94303 (415) 493-2223	Apple II, III IBM - PC	Plan 4000 links up to 64 workstations workstations over a distance of up to four miles using baseband coaxial cable. The computer and peripheral interface cards contain an intelligent chip--called Resource Interface Module (RIM)--to serve as the network master controller. The network file server is attached to a hard disk drive.

*Based on Rothfeder, J. Networking the work place. Personal Computing. June 1983, 7(6), 85.

Program/Company (Cost)	Computers	Description
ARCnet Interface card, $495; Network file server (with 10-MB drive), $10,000 Datapoint Corp. 9725 Datapoint Dr. San Antonio, TX 78284 (512) 699-700	Datapoint (TRS-80, model 16 and Node II by end of 1983)	ARCnet links up to 255 computers over a distance of up to four miles using baseband coaxial cables. The interface card contains the same intelligent chip--the RIM--as the one used in Nestar's PLAN 4000. The network file server is attached to a hard disk drive. Tandy Corporation has announced that it plans to have its Radio Shack Model 16 and Model II computers support ARCnet by the end of the year.
ETHERSHARE Interface card, $950; Network file server (with 10-MB drive), $11,500 3Com Corp. 1390 Shorebird Way Mountain View, CA 94043 (415) 961-9602	IBM - PC Apple (by late '83)	EtherShare and all other 3Com products operate on the Ethernet* network. An intelligent chip is connected to the interface card to manage the network. The file server, if a hard disk drive is not chosen, can also be a dedicated computer.
***ETHERNET** Xerox Corp. 6416 Wrenchwood Rd. Dallas, TX 75252 (214) 689-6045		Ethernet is an attempt to create a universal networking standard for computers. It is a coaxial baseband bus network that will hook up 1024 workstations over a distance of 2.5 kilometers. Its architecture and topology is not proprietary so separate distributors sell Ethernet-compatible products.
APPLENET Interface card, $500; Network file server, (to be announced) Apple Corp. 20525 Mariani Ave. Cupertino, CA 95014 (408) 996-1010	Apple Computers	Apple Net is just reaching market. It can accommodate workstations over a distance of 8000 feet in a bus configuration.

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References

Neumann, R. Data banks: Opening the door to a world of information. Electronic Learning, November-December 1982, 56; 58-61; 83.

Rothfeder, J. Networking the work place. Personal Computing. June 1983, 7(6), 85.

PLANNING FOR MICROCOMPUTER USE

People often find it is difficult to decide whether or not to buy a computer or what computer to buy without knowing what "capabilities" computers have. It should be clear from this workshop that a computer is a very sophisticated, generic tool that can be supplied with multiple capabilities including: word processing, data base management, calculation and statistical analysis, graphics, and communication. The only restriction is that the program having the instructions for these capabilities must be compatible with a given system in terms of the system's central processing unit, random access memory size, disk operating system and auxiliary storage features, and so on. Therefore, in making decisions about computers, one should start with an analysis of capabilities in relation to classes of software.

A three-step process can be used to guide one from the consideration of capabilities to the selection of a microcomputer system.

Step 1: Know Your Needs

The best place to begin is with an analysis of the tasks you do that could be accomplished using a particular microcomputer based program. These may be listed on a form such as that shown on the following pages, "Tasks/Software Matrix." Obviously, many tasks could be accomplished with the aid of a microcomputer; the question is, which ones should be transferred to a computer system? The following are some criteria to use in describing which tasks should be transferred:

1. Identify and eliminate tasks that are already being efficiently accomplished

2. Rate the remaining tasks in terms of
   a. potential for time/cost savings
   b. relative importance

Rating the tasks can be based on the general capabilities of software. For example, if much production typing is done, and any one document goes through many drafts, a word processing program would save the time and money associated with repeated typings.

Step 2: Identify The Best Software

Once the top priority tasks are identified, the most appropriate software must be selected. This is where the evaluations presented in the various buyer's guides listed in each reference section of the workshop materials come in handy. These guides typically present extensive lists of programs with some

identification of their features. The features are the ones described in the narrative sections of the workshop materials. For example, a buyer's guide to data base systems might include: number of records per file, number of fields per record, maximum field size, whether the files are fixed or variable, format of files, index scheme, special features, hardware requirements.

Evaluating software beyond the features listed in buyer's guides can be very confusing. The criteria listed in the following section, "Criteria for Review of Professional Software," are intended to facilitate reviewing professional software. They are grouped under the following topics: description of the package, documentation, inputs/operation, outputs, and general characteristics. The only way to assess software in regard to these criteria is to try it out.

Step 3: Identify Appropriate Hardware

As noted above, many software buyer's guides include hardware requirements. The form "Hardware Specifications Worksheet" on the following pages lists various hardware specifications. A separate sheet can be generated for each software package. Hardware selection can then be made based on the number of preferred packages that will run on a particular system. A formal way to make such a decision is shown in the "Hardware Evaluation Worksheet" shown at the end of this section. In making a final choice regarding a system, it is important to be aware of the families of microcomputers and the machines belonging to each family.

Compatibility among machines in a given family can broaden the range of possible choices. There are various types of compatibility. These include:

- complete software compatibility
- video compatible
- disk compatible
- operating system compatible
- compatible central processor chip

A demonstration of a particular software package on a particular system is the only sure way of proving compatibility.

Tasks/Software Matrix

Software Types / Tasks	Word Processing Enter, edit, and print text	File Management Create & maintain records; print reports	Spreadsheets Organize and manipulate numbers	Test Generation Create, edit & print instruments	Data Collection Gather data directly or via mark sense	Statistical Analyse and summarize data	Graphics Display results of data manipulation	Telecom. & Networking Communicate among computers

Criteria for Review of Professional Software*

Description

Title of package
Producer
Costs: initial copy, backup copy, multiple copies, updates
Purpose of the package
Intended audience
Package components
Hardware requirements: brand of computer, memory size required, number disk drives required

Software requirements: operating system, languages

Product capacities: maximum number student records, record length or field size, number data disks supported

Product outputs: reports, graphics

Service and support: installation assistance, staff training, documentation & software updates, telephone hotline, procedure for repairing system problems (debugging)

Documentation

Index
Table of contents
Help section
System overview
Illustrations of screen displays
Sample reports
Information on hardware and operations: capacity of system and individual file

Inputs/Operation

Allowable input field sizes are delineated
Data fields conform to appropriate standards
Optional and/or user-defined data fields are available

There is an editing option prior to or in conjunction with entry of each set of data

The package permits only acceptable data to be entered; it has error-handling facilities

The package is menu-driven

*Developed by Don Holznagel, Director, Computer Technology Program, Northwest Regional Educational Laboratory.

Records are retrievable by record number, name of record, student, or other title

The number of records in use can be displayed

A message appears when the file capacity is approached

The capacity to copy data files appears on an appropriate menu or in the program documentation

The package provides for easy or automatic restart and recovery

Date entry procedures are consistent from module to module (in systems consisting of several modules)

The various displays provide adequate instruction and prompts to the user concerning how to enter data in the system

The package advises the user when the program is functioning correctly and incorrectly, and how to correct errors

Users can appropriately define code options, charts of accounts, etc.

The program runs at an acceptable speed

Outputs

The program provides outputs which are appropriate for its purpose

The package provides options for screen display of hard copy outputs, and vice versa

Reports are easy to read and use, with meaningful abbreviations, adequate spacing and legible print

Screen displays are readable

General

The package is easy to install and use

The package makes effective use of the computer; that is, it provides real advantages over manual methods

The program is flexible in being able to be adjusted to local needs

The program works and does the tasks it purports to do

The software provides for protection against casual access to confidential data

Hardware Specifications Worksheet

Software Package (name): _____

(company): _____

(cost): _____

Microcomputer:

Active Memory (RAM) Size:

_____ 16K _____ 32K _____ 48K _____ 64K _____ more

Operating system: _____ CP/M, _____ Apple-DOS, _____ TRS-DOS, _____ MS-DOS

_____ Other (specify) _____

Keyboard:

_____ touch typing, (QWERTY)- _____ numeric keypad,

_____ special function keys, _____ cursor keys (←, →, ↑, ↓)

Monitor:

_____ black/white, _____ green _____ amber _____ color

_____ 40 column _____ 80 column

_____ 24 lines _____ full page

Graphics:

_____ not needed _____ low resolution _____ high resolution

Auxiliary Storage:

_____ 5" _____ 8" flexible disk:

_____ single sided, _____ single density,

_____ double sided, _____ double density

_____ <10m _____ >10m hard disk

Printer: _____ dot matrix _____ dot matrix w/graphics _____ letter quality

_____ friction feed _____ pin feed _____ single sheet feed

_____ 8 1/2" wide _____ 11" wide _____ 14" wide

Modem: _____ 300 baud _____ 1200 baud _____ other

_____ acoustic coupler _____ direct connect

Other: _____ graphics tablet _____ graphics plotter

_____ mark sense reader

Cost:

HARDWARE EVALUATION WORKSHEET

A Weighted Decision Technique

CRITERIA	COMPUTER RATINGS A	B	C	WEIGHT	RATINGS X WEIGHT A	B	C
Software avail.							
Specific uses							
Potential uses							
Features/Capac.							
Graphics							
Keyboard							
Memory							
Expansion							
Disk drives							
Service							
Tech. Support							
Cost of full system							
				TOTALS: 1.0	____	____	____

NOTE:

1) Have each participant rate each computer on each criteria using the following scale:

   3 Strong point
   2 Satisfactory
   1 Weak point

2) Average these ratings for each computer across participants and enter in the appropriate column of this worksheet.

3) Determine the importance of each criteria and assign a weight. The weights can be proportions (e.g. .25) which sum to one. For example, "Software availability" should be rated quite high, perhaps .25 or .35

4) Multiply each rating by the weight for that criteria.

5) Sum the weights for each computer. These totals reflect the overall ratings for each computer. Disregard small differences.

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FAMILIES OF MICROCOMPUTERS

(Software compatiblity)

APPLE

Apple II+
Apple IIe
Apple III
Franklin Ace
Basis

TRS (RADIO SHACK)

TRS80 Model II
TRS80 Model III
TRS80 Model IV
MTI

CP/M based

North Star Advantage
TRS80 Model II, IV
Osborne 1
Osborne Executive 1, 2
Kaypro
TeleVideo 805, 810
Cromemco
DEC Rainbow 100
Xerox 820
NEC

(with special hardware includes Apple II, some Commodores, IBM PC)

IBM PC compatible (MSDOS, CP/M-86)

IBM PC
IBM XT
Compaq
DOT
Hyperion
Osborne Executive 2
DEC Rainbow 100
North Star Advantage 8/16
Zenith Z-100

How compatible is compatible?

Complete software compatibility (rare)

Video compatible

Disk compatible

Operating system compatible

Compatible central processor chip

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